Table 1

Acc # 1-Vehicle Motion
Acc # 2-Wheel Angle
Light Sensor - Ambient
Temp Sensor - Ambient
Sounder
Mark Button

Table 2

W - Wheel Rotation Angle
X - Measured component of g in sensor axis (m/s/s)
K wheel - Sensor scaling factor (mm/s/s/bit)
g - Gravity 9.81 m/s/s
g - Gravity Vector Component in wheel Plane

$\text{Sin } W = X / g$

$X = k \text{ wheel} / 1000 \times (Ch(1)\text{-ZeroWheel}) \times 1/\text{Cos}(\text{Alpha})$

$\text{Sin } W = k \text{ wheel} / (1000 \times g) \times (Ch(1)\text{-ZeroWheel}) \times (1/\text{Cos}(\text{Alpha}))$

$W + \text{ArcSin} [\text{Kwheel} / (1000 \times g) \times (Ch(1)\text{-ZeroWheel}) \times 1/\text{Cos}(\text{Alpha})]$

Table 3

$$\text{RMS Steering Angle- } R(\text{Deg}) = \sqrt{\frac{\sum \text{Wheel}[n]^2}{n}}$$

Table 4

Bound Check	
W Limit- < W < W Limit+	Steering Mode=Corrective
W < W Limit-	Steering Mode=Active
W > W Limit+	Steering Mode=Active

Table 5

RMS Vehicle Acceleration-G(m/s/s) = $\sqrt{\frac{\sum Acc[n]^2}{n}}$

Table 6

T cycle = 60s T monitor = 50s T process = 10s	Calculate Parameters Test & Issue Warnings Update Screen Display Store Sensor Data > Disk Store Calculated Parameters > Disk

Table 7

Note:

Data storage @ 1Hz
ZeroAcc=Average {RawAcc[n]}
ZeroWheel=Average {RawWheel[n]}
Ch(N)=Raw ADC Value (bit)

Table 8

Acc[n] = Kacc/1000 x (RawAcc[n]-ZeroAcc)x1/Cos(Alpha)

(m/s/s) (mm/s/s/bit) (bit) (bit)

Wheel[n] = ArcSin [Kwheel/(1000x9.81) x (RawWheel[n]-ZeroWheel)x1/Cos(Alpha)]

(Deg) (mm/s/s/bit) (bit) (bit)

I = Klight/1000 x (Ch(2)-ZeroLight)

(KLx) (Lx/bit) (bit) (bit)

T = Ktemp/1000 x (Ch(3) - ZeroTemp)

(DegC) (mDegC/bit) (bit) (bit)

Table 9

Engineering Scaling Factors	
K acc (mm/s/s/bit)	Acceleration Channel
K wheel (mm/s/s/bit)	Steering Channel
K light (Lx/bit)	Light Channel
K temp (mDegC/bit)	Temp Channel
ZeroLight (bit)	Intercept adjust - Light
ZeroTemp (bit)	Intercept adjust - Temp
Alpha (Deg)	Steering Wheel Inclination from Vertical
Hysterisis (Deg)	Hesterisis factor - Zero X analysis

Table 10

Sleep Propensity Algorithm - Definition	
S mod=S circ + S zerox + S rms + S light + S temp + S sleep + S road + S trip	
Elemental	Bound Limit
S mod	0<S mod <1
S circ	0<S circ <1
S zerox = (F zerox/100) (Z ref-Z)	0<S zerox
S rms = (F rms/100) (R-R ref)	0<S rms
S light = (F light/100) (I ref -I)	0<S light
S temp = (F temp/100) (T -T ref)	0<S temp
S sleep = (F sleep/100) (H ref - (HxQ))	0<S sleep
S road = (F road/100) (G ref -G)	0<S road
S trip = (F trip/100) x D	0<S trip

Table 11

Algorithm Elementals - S	
S mod (S)	Modified Sleep Propensity Factor-Range 0...1
S circ (S)	Current Circadian Sleep Propensity Value
S zerox (S)	Current Corrective Steering Reversal Rate Deficit
S rms (S)	Current RMS Corrective Steering Amplitude Surfit
S light (S)	Current Ambient Lighting Intensity Deficit
S temp (S)	Current Ambient Temperature Surfit
S sleep (S)	Prior Sleep Good Hours Deficit
S road (S)	Current Road Activity Deficit
S trip (S)	Accumulated Trip Duration

Table 12

Algorithm Weighting Factors - F	
Note : Factors are % S Unit per Parameter Unit	
F zerox (%S/#/min)	Corrective Steering Reversal Rate Deficit - % Factor
F rms (%S/Deg)	RMS Corrective Steering Amplitude Surfit - % Factor
F light (%S/kLx)	Average Ambient Lighting Intensity Deficit - % Factor
F temp (%S/DegC)	Average Ambient Temperature Surfit - % Factor
F sleep (%S/Hr)	Prior to Good Hours Sleep Deficit - % Factor
F road (%S/m/s/s)	Road Activity Deficit - % Factor
F trip (%S/Hr)	Accumulated Trip Duration - % Factor

Table 13

Algorithm Reference Offfsets - ref	
Z ref (#/min)	Corrective Steering Reversal Rate - Ref Offset Corresponds to 'Alert ' Driving Subject Dependent
R ref (Deg)	Corrective Steering RMS Amplitude - Ref Offset Corresponds to 'Alert ' Driving Subject Dependent
I ref (kLx)	Average Ambient Lighting Intensity - Ref Offset Corresponds to moderate daylight
T ref (DegC)	Average Ambient Temperature - Ref Offset Corresponds to moderate environment
H ref (Hr)	Prior to Good Hours Sleep - Ref Offset Corresponds to optimum value
G ref (m/s/s)	Road Activity - RMS Acceleration / Deceleration - Ref Offset

Table 14

Algorithm Dynamic Variables	
Z (#/min)	Current Corrective Steering Zero X Rate
R (Deg)	Current RMS Correvtive Steering Amplitude
I (kLx)	Current Ambient Lighting Intensity
T(DegC)	Current Ambient Temperature
G (m/s/s)	Current Road Activity - RMS Acceleration / Deceleration
D(Hr)	Accumulated Trip Duration
H(Hr)	Actual Hours of Prior Sleep
Q (#)	Prior Sleep Quality - Normalised Scale 0...1
Qx (#)	Prior Sleep Quality User Scale 1,2,3,4,5 Q=Qx/5

Table 15

Steering Mode & Steering Limit -W limit	
W limit (Deg)	Decision limit - Steering mode detection +W limit >W> -W limit >>> Corrective +W limit <W< -W limit >>> Active
Steering Mode	Steering mode decision ACTIVE, CORRECTIVE

Table 16

Alarm Levels & Alarm State	
Alarm Level 1 (s)	Alarm level threshold
Alarm Level 2 (s)	Alarm level threshold
Alarm Level 3 (s)	Alarm level threshold
Alarm Holdoff (min)	Initial alarm forced hold-off time - N minutes
Alarm State	Alarm status decision CLEAR, LEVEL1, LEVEL2, LEVEL3, HOLDOFF

Table 17

User Software Functions	
Set Display Parameters	
Enter New Values and <RET> or <RET> to bypass edit option.	
Display History (min)	Graphic display history length - Last N minutes
FSD (S)	Graphic display full scale - S unit (0.. 1)

Table 18

Data Directiory Structure
[ALGO] *.ALG Algorithm Data Files - Internal Format
[USER]*.ALG User Data Files - Internal Format
[XALGO]*.CSV Algorithm Data Files - CSV Format
[XUSER]*.CSV User Data Files - CSV Format
[XDRIVE]*.CSV Drive Mode Data Files - CSV Format
[XLEARN]*.CSV Learn Mode Data Files - CSV Format

Table 19

File Structure - Program Internal Format

Note : These files in program internal readable format

Configuration File - SLEEPALT.CFG

Save Set Values @ Program Shut Down
Load Set Value @ Program Initialisation

K acc	(mm/s/s/bit)
K wheel	(mm/s/s/bit)
K light	(Lx/bit)
K temp	(mDegC/bit)
K batt	(mV/bit)
ZeroLight	(bit)
ZeroTemp	(bit)
Hysterysis	(Deg)
Alpha	(Deg)
AlgorithmID	
UserID	
Circ[0] ... [23]	(S)
FSD	(0.. 1)
DisplayHist	(min)

Table 20

Algorithm Data File [ALGO]*.ALG	
F zerox	(%S/#/min)
F rms	(%S/Deg)
F light	(%S/Klx)
F temp	(%S/DegC)
F sleep	(%S/Hr)
F road	(%S/m/s/s)
F trip	(%s/Hr)
Z ref	(#/min)
R ref	(Deg)
I ref	(KLx)
T ref	(DegC)
H ref	(Hr)
G ref	(m/s/s)
Alarm1	(s)
Alarm2	(s)
Alarm3	(s)
AlarmHoldoff	(min)
W limit	(Deg)

Table 21

User Data File [USER]*.USR
UserName
UserDoB
UserSex

Table 24

Data File Structure - Algorithm Data File [XALGO]*.CSV

Note : These files in external readable format - CSV

AlgorithmID

File Creation Date

F zerox (%S/#/min)

F rms (%S/Deg)

F light (%S/kLx)

F temp (%S/DegC)

F sleep (%S/Hr)

F road (%S/m/s/s)

F trip (%S/Hr)

Z ref (#/min)

R ref (Deg)

I ref (KLx)

T ref (DegC)

H ref (Hr)

G ref (m/s/s)

Alarm1 (s)

Alarm2 (s)

Alarm3 (s)

AlarmHoldOff (min)

W limit (Deg)

Table 22

Data File Structure - Drive Mode Data File [XDRIVE]*.CSV

Note: These files in external readable format - CSV

DriveID
File Ceation Date
Start Time (Hr 0.. 23)
Start Time (min 0.. 59)
UserID
AlgorithmID

Alarm1 (s)
Alarm2 (s)
Alarm3 (s)
AlarmHoldOff (min)

W limit (Deg)

H (Hr)
Q (0.. 1)

F zerox (%S/#/min)
F rms (%S/Deg)
F light (%S/kLx)
F temp (%S/DegC)
F sleep (%S/Hr)
F road (%S/m/s/s)
F trip (%S/Hr)

Z ref (#/min)
R ref (Deg)
I ref (Kix)
T ref (DegC)
H ref (Hr)
G ref (m/s/s)

Minute Count (min) ..... Repeat 1 .. N(min)
AlarmState
SteeringMode
Acceleration [1](m/s/s) Wheel[1](Deg)

Acceleration [50] Wheel[50]

Z (#/min)
R (Deg)
I (KLx)
T (DegC)
G (m/s/s)
D (Hr)

S mod (S)
S circ (S)
S zerox (S)
S rms (S)
S temp (S)
S sleep (S)
S road (S)
S trip (S)

DQC (Data Quality Code 0..255)

Table 23

Data File Structure - Learn Mode Data File [XLEARN]*.CSV

Note : These files in external readable format - CSV

Data File Structure - User Data File [XUSER]*.CSV

Note : These files in external readable format - CSV

UserID
File Creation Date

UserName
UserDoB
UserSex